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JAMES & WELLS
INTELLECTUAL PROPERTY

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CONFIRMATION

Confirmation to follow

2 March 2005
CHRISTCHURCH OFFICE

IP Australia
P O Box 200
Woden, ACT 2606
AUSTRALIA

Attention: Rajeev Deshmukh

Re: PCT Application No. PCT/NZ2003/00279
AgResearch Limited
MEASUREMENT APPARATUS AND METHOD
Our Ref: 42550/X288

Thank you for your first Written Opinion dated 4th August 2004.

Referring to that Opinion:

Novelty and inventive step objections

In light of the examiner's objections, the claims have been amended to incorporate the subject matter of claim 5 into claim 1. A copy of the amended claim set (numbering 1-19) is **enclosed** to replace the original claims 1-20. The claim sets are identical with the exception of the above-described amendments to claim 1, the deletion of former claim 5, and the amendment to independent method claim 17 to incorporate the apparatus as claimed in the preceding apparatus claims.

VIII
1 & 2: It is submitted the terms *'at least substantially'* is a widely recognised and accepted term in patent specifications and would be clearly interpreted within the context of a patent by the skilled addressee. Similarly, the terms *'adjacent or in contact with a surface'* is not ambiguous given the nature of the invention nor the interpretive knowledge of the addressee in the field of the invention. The claims state the effect in terms of electro-magnetic radiation detection that is required when effecting placement of the detector

CHRISTCHURCH OFFICE
Level II, PricewaterhouseCoopers Centre
119 Armagh Street
Christchurch
PHONE +64 3 379 3664
FAX +64 3 379 8220
EMAIL christchurch@jaws.co.nz
HOMEPAGE www.jaws.co.nz
POST PO Box 2201
Christchurch, New Zealand
DX WP20323, Christchurch

AUCKLAND OFFICE
PHONE +64 9 914 6740
FAX +64 9 914 6760
POST Private Bag 11907
Ellerslie, Auckland, New Zealand
DX CP34005, Auckland

HAMILTON OFFICE
PHONE +64 7 957 5660
FAX +64 7 957 5661
POST Private Bag 3140
Hamilton, New Zealand
DX GX10012, Hamilton

TAURANGA OFFICE
PHONE +64 7 578 4666
FAX +64 7 578 4001
POST PO Box 13365
Tauranga, New Zealand
DX HP40037, Tauranga

and emitter. Configurations failing to meet these requirements would thus be outside the bounds of the claims and thus they are neither vague nor indeterminate.

3: It is agreed that the level of technical detail in WO 1998/001747 and the like differs from that of the present invention. However, it is drawn to the Examiner's attention that the present invention does not seek to protect the fundamental operating principles of temperature determination using microwave measurements, these being well established in the art. The present invention is directed solely to the optimum placement of the emitter and detector during such measurements and as such, such additional technical detail is superfluous.

A copy of the amended pages showing the tracked amendments and a clean copy is **enclosed**. Corresponding amendments have been made to the patent description on pages 9 and 10, and a copy of these pages is also **enclosed** (marked-up and clean copy).

We trust the above comments overcome this Examiner's objection, and we look forward to hearing from you.

Yours sincerely
JAMES & WELLS

Andy Cable
Associate
andyc@jaws.co.nz

not passing though the object. This is particularly useful for temperature measurements, where the transmissivity of the object to the incident electromagnetic radiation varies according to temperature.

Thus, according to one embodiment of the present invention, said apparatus is configurable to perform temperature measurements by positioning of the emitter immediately adjacent the surface of said object and positioning said detector on an opposing side of the object such that the detector solely, or at least substantially receives electromagnetic radiation transmitted through the object from the emitter.

In particular, the invention is suited to, but not restricted to, temperature measurements using microwave radiation.

According to one embodiment of the present invention there is provided an apparatus for measuring the temperature of an object, said apparatus including:

- a microwave emitter and a microwave detector

characterised in that the apparatus further includes a drive apparatus capable of reversibly placing the said emitter immediately adjacent to, or in contact with, a surface of the object, wherein to perform temperature measurements, said microwave emitter is positioned by said drive apparatus immediately adjacent the surface of said object and said detector is positioned on an opposing side of the object such that the microwave detector solely, or at least substantially receives microwave radiation transmitted through the object from the microwave emitter.

According to another aspect of the present invention there is provided a method of measuring the temperature of an object using microwave radiation, characterised by the steps of:

- positioning a microwave emitter immediately adjacent or in contact with a surface of said object;

- positioning a microwave detector on an opposing side of the object to said emitter;

such that the microwave detector solely, or at least substantially receives microwave radiation transmitted through the object from the microwave emitter.

As used herein, the term object is to be interpreted widely and includes any substance, material, or organic matter, particularly those containing moisture and/or any other substance where the transmittivity of electromagnetic radiation energy changes measurably with temperature.

In one embodiment, said object is frozen, near frozen or chilled.

It will be appreciated however that the present invention is not necessarily limited to the temperature measurements of frozen or chilled objects. Alternative (non-temperature related) uses may be made of the measurements produced by the present invention.

~~Preferably, the present invention further includes drive apparatus capable of reversibly placing the said emitter immediately adjacent to, or in contact with, a surface of the object.~~

Optionally, the present invention also includes drive apparatus capable of reversibly placing the detector on an opposing side of said object to said emitter.

According to one aspect of the present invention, said drive apparatus is a linear actuator including, but not limited to, pneumatic, hydraulic, electro-mechanical operated actuators.

The drive apparatus/emitter assembly may further include a proximity sensor capable of determining the proximity of the object to the emitter. Thus, the emitter may be reliably and repeatably placed at the same degree of proximity to each object without

Claims:

1. An apparatus for measuring the transmission or attenuation of electromagnetic radiation through an object, said apparatus including an electromagnetic radiation emitter and detector,

   characterised in that the apparatus further includes a drive apparatus capable of reversibly placing the said emitter immediately adjacent or in contact with a surface of the object, wherein to perform transmission/attenuation measurements, ~~the apparatus is configurable such that~~ said emitter is positioned by said drive apparatus immediately adjacent the surface of said object and said detector is positioned on an opposing side of the object such that the detector solely, or at least substantially receives electromagnetic radiation transmitted through the object from the emitter.

2. The apparatus as claimed in claim 1, wherein said apparatus is configurable to perform temperature measurements by positioning of the emitter immediately adjacent the surface of said object and positioning said detector on an opposing side of the object such that the detector solely, or at least substantially receives any electromagnetic radiation transmitted through the object from the emitter.

3. The apparatus as claimed in claim 1 or claim 2, wherein said object includes any substance, material, or organic matter containing moisture and/or any other substance where the transmittivity of electromagnetic radiation energy changes measurably with temperature.

4. The apparatus as claimed in any one of the preceding claims, wherein said object is frozen, near frozen or chilled.

~~5.The apparatus as claimed in any one of the preceding claims, further including~~

~~drive apparatus capable of reversibly placing the said emitter immediately adjacent or in contact with a surface of the object.~~

~~6.~~5. The apparatus as claimed in claim ~~5~~4, wherein said drive apparatus is capable of reversibly placing the said microwave detector on an opposing side of said object to said emitter.

~~7.~~6. The apparatus as claimed in any one of claims ~~5~~ 4 - ~~6~~5, wherein said drive apparatus is a pneumatic, hydraulic, or electro-mechanical operated linear actuator.

~~8.~~7. The apparatus as claimed in any one of claims ~~5~~ 4 - ~~7~~6, wherein the drive apparatus/emitter assembly further includes a proximity sensor capable of determining the proximity of the object to the emitter.

~~9.~~8. The apparatus as claimed in claim ~~8~~7, wherein the proximity sensor is an ultrasonic sensor.

~~10.~~9. The apparatus as claimed in any one of the preceding claims, wherein said detector is positionable immediately adjacent to, or in contact with, said object.

~~11.~~10. The apparatus as claimed in any one of claims 1-~~9~~8, wherein said detector is located proximate to, but not in contact with said object.

~~12.~~11. The apparatus as claimed in any one of the preceding claims, further including a moving conveyance configured to transport a plurality of objects along a primary axis of travel passing between the emitter and detector.

~~13.~~12. The apparatus as claimed in claim ~~12~~11, wherein the moving conveyance includes conveyor systems, pallet-handling systems, automated cargo transport systems, robotic, manual or human-operated object handling

and/or transportation systems.

~~14.~~13. The apparatus as claimed in any one of claims 1-4, wherein the microwave emitter and detector are manually positionable on opposing sides of an object for temperature measurement.

~~15.~~14. A method of measuring the transmission or attenuation of electromagnetic radiation through successive objects using the apparatus claimed in claim ~~12~~11 or ~~13~~12, comprising the steps;

- successively transporting objects via said conveyance system between the emitter and detector along the primary axis of travel;
- positioning the emitter adjacent to, or in contact with, each object when interposed between said emitter and detector;
- performing an electromagnetic radiation transmission or attenuation measurement;
- moving the emitter away from the object.

~~16.~~15. The method as claimed in claim ~~15~~14 including the further step of;

- positioning the detector adjacent to, or in contact with, each object when interposed between said emitter and detector prior to performing the electromagnetic radiation transmission or attenuation measurement;
- moving the detector away from the object.

~~17.~~16. An apparatus for measuring the temperature of an object, said apparatus including:

- a microwave emitter and a microwave detector;

characterised in that to perform temperature measurements, said microwave emitter is positionable immediately adjacent the surface of said object and said detector is positioned on an opposing side of the object such that the microwave detector solely, or at least substantially receives microwave radiation transmitted through the object from the microwave emitter.

~~18.~~17. A method of measuring temperature of an object using microwave radiation using the apparatus as claimed in claims 1-16, said method characterised by the steps of:

- positioning a microwave emitter immediately adjacent or in contact with a surface of said object;
- irradiating the object with microwave radiation from the emitter;
- positioning a microwave detector on an opposing side of the object to said emitter such that microwave detector solely, or at least substantially receives microwave radiation transmitted through the object from the microwave emitter.
- calculating the object temperature from said microwave radiation received by the detector.

~~19.~~18. An apparatus substantially as hereinbefore described with reference to, and as shown in the drawings.

~~20.~~19. A method substantially as hereinbefore described with reference to, and as shown in the drawings.

not passing though the object. This is particularly useful for temperature measurements, where the transmissivity of the object to the incident electromagnetic radiation varies according to temperature.

Thus, according to one embodiment of the present invention, said apparatus is configurable to perform temperature measurements by positioning of the emitter immediately adjacent the surface of said object and positioning said detector on an opposing side of the object such that the detector solely, or at least substantially receives electromagnetic radiation transmitted through the object from the emitter.

In particular, the invention is suited to, but not restricted to, temperature measurements using microwave radiation.

According to one embodiment of the present invention there is provided an apparatus for measuring the temperature of an object, said apparatus including:

- a microwave emitter and a microwave detector

characterised in that the apparatus further includes a drive apparatus capable of reversibly placing the said emitter immediately adjacent to, or in contact with, a surface of the object, wherein to perform temperature measurements, said microwave emitter is positioned by said drive apparatus immediately adjacent the surface of said object and said detector is positioned on an opposing side of the object such that the microwave detector solely, or at least substantially receives microwave radiation transmitted through the object from the microwave emitter.

According to another aspect of the present invention there is provided a method of measuring the temperature of an object using microwave radiation, characterised by the steps of:

- positioning a microwave emitter immediately adjacent or in contact with a surface of said object;

- positioning a microwave detector on an opposing side of the object to said emitter;

such that the microwave detector solely, or at least substantially receives microwave radiation transmitted through the object from the microwave emitter.

As used herein, the term object is to be interpreted widely and includes any substance, material, or organic matter, particularly those containing moisture and/or any other substance where the transmittivity of electromagnetic radiation energy changes measurably with temperature.

In one embodiment, said object is frozen, near frozen or chilled.

It will be appreciated however that the present invention is not necessarily limited to the temperature measurements of frozen or chilled objects. Alternative (non-temperature related) uses may be made of the measurements produced by the present invention.

Optionally, the present invention also includes drive apparatus capable of reversibly placing the detector on an opposing side of said object to said emitter.

According to one aspect of the present invention, said drive apparatus is a linear actuator including, but not limited to, pneumatic, hydraulic, electro-mechanical operated actuators.

The drive apparatus/emitter assembly may further include a proximity sensor capable of determining the proximity of the object to the emitter. Thus, the emitter may be reliably and repeatably placed at the same degree of proximity to each object without risk of impact. In one embodiment, the proximity sensor is an ultrasonic sensor.

Claims:

1. An apparatus for measuring the transmission or attenuation of electromagnetic radiation through an object, said apparatus including an electromagnetic radiation emitter and detector,

   characterised in that the apparatus further includes a drive apparatus capable of reversibly placing the said emitter immediately adjacent or in contact with a surface of the object, wherein to perform transmission/attenuation measurements, said emitter is positioned by said drive apparatus immediately adjacent the surface of said object and said detector is positioned on an opposing side of the object such that the detector solely, or at least substantially receives electromagnetic radiation transmitted through the object from the emitter.

2. The apparatus as claimed in claim 1, wherein said apparatus is configurable to perform temperature measurements by positioning of the emitter immediately adjacent the surface of said object and positioning said detector on an opposing side of the object such that the detector solely, or at least substantially receives any electromagnetic radiation transmitted through the object from the emitter.

3. The apparatus as claimed in claim 1 or claim 2, wherein said object includes any substance, material, or organic matter containing moisture and/or any other substance where the transmittivity of electromagnetic radiation energy changes measurably with temperature.

4. The apparatus as claimed in any one of the preceding claims, wherein said object is frozen, near frozen or chilled.

5. The apparatus as claimed in claim 4, wherein said drive apparatus is capable

of reversibly placing the said microwave detector on an opposing side of said object to said emitter.

6. The apparatus as claimed in any one of claims 4 - 5, wherein said drive apparatus is a pneumatic, hydraulic, or electro-mechanical operated linear actuator.

7. The apparatus as claimed in any one of claims 4 - 6, wherein the drive apparatus/emitter assembly further includes a proximity sensor capable of determining the proximity of the object to the emitter.

8. The apparatus as claimed in claim 7, wherein the proximity sensor is an ultrasonic sensor.

9. The apparatus as claimed in any one of the preceding claims, wherein said detector is positionable immediately adjacent to, or in contact with, said object.

10. The apparatus as claimed in any one of claims 1-8, wherein said detector is located proximate to, but not in contact with said object.

11. The apparatus as claimed in any one of the preceding claims, further including a moving conveyance configured to transport a plurality of objects along a primary axis of travel passing between the emitter and detector.

12. The apparatus as claimed in claim 11, wherein the moving conveyance includes conveyor systems, pallet-handling systems, automated cargo transport systems, robotic, manual or human-operated object handling and/or transportation systems.

13. The apparatus as claimed in any one of claims 1-4, wherein the microwave emitter and detector are manually positionable on opposing sides of an object for temperature measurement.

14. A method of measuring the transmission or attenuation of electromagnetic radiation through successive objects using the apparatus claimed in claim 11 or 12, comprising the steps;

- successively transporting objects via said conveyance system between the emitter and detector along the primary axis of travel;
- positioning the emitter adjacent to, or in contact with, each object when interposed between said emitter and detector;
- performing an electromagnetic radiation transmission or attenuation measurement;
- moving the emitter away from the object.

15. The method as claimed in claim 14 including the further step of;

- positioning the detector adjacent to, or in contact with, each object when interposed between said emitter and detector prior to performing the electromagnetic radiation transmission or attenuation measurement;
- moving the detector away from the object.

16. An apparatus for measuring the temperature of an object, said apparatus including:

- a microwave emitter and a microwave detector;

characterised in that to perform temperature measurements, said microwave emitter is positionable immediately adjacent the surface of said object and said detector is positioned on an opposing side of the object such that the microwave detector solely, or at least substantially receives microwave radiation transmitted through the object from the microwave emitter.

17. A method of measuring temperature of an object using microwave radiation using the apparatus as claimed in claims 1-16, said method characterised by the steps of:

    - positioning a microwave emitter immediately adjacent or in contact with a surface of said object;
    - irradiating the object with microwave radiation from the emitter;
    - positioning a microwave detector on an opposing side of the object to said emitter such that microwave detector solely, or at least substantially receives microwave radiation transmitted through the object from the microwave emitter.
    - calculating the object temperature from said microwave radiation received by the detector.

18. An apparatus substantially as hereinbefore described with reference to, and as shown in the drawings.

19. A method substantially as hereinbefore described with reference to, and as shown in the drawings.